Claims

1. A power supply for inductively heating or melting an electrically conductive material, the power supply comprising:

a rectifier for converting an ac input power into a dc output power at the output of the rectifier;

an inverter having an input connected to the output of the rectifier, the inverter converting the dc output power of the rectifier into an ac output current supplied to an output of the power supply, the ac output current having a frequency equal to the operating frequency of the inverter;

an at least one tuning capacitor connected across the output of the rectifier and the input of the inverter;

an autotransformer connected to the output of the power supply, the autotransformer having a first autotransformer output terminal and a plurality of second autotransformer output terminals, the plurality of second autotransformer output terminals comprising at least two autotransformer taps; and

an at least one inductive load coil connected across the first autotransformer terminal and one of the plurality of second autotransformer terminals, the at least one inductive load coil, in combination with the connected impedance of the autotransformer, having an impedance so that it is at least approximately in resonance with the at least one tuning capacitor at the operating frequency of the inverter, whereby the electrically conductive material is inductively heated or melted by a magnetic field generated from the flow of the ac output current through the at least one inductive load coil.

2. A method of inductively heating or melting an electrically conductive material, the method comprising the steps of:

rectifying an ac input power into a dc output power;

inverting the dc output power to produce an output ac current from an inverter at an operating frequency of the inverter;

connecting the output ac current to an autotransformer, the autotransformer having a first autotransformer terminal and a plurality of second autotransformer terminals comprising at least two autotransformer taps;

connecting an at least one inductive load coil across the first autotransformer terminal and one of the plurality of second autotransformer terminals to generate a magnetic field that magnetically couples with the electrically conductive material to

inductively heat or melt the electrically conductive material; and

forming an at least approximately resonant circuit at the operating frequency of the inverter with the at least one inductive load coil in combination with the connected impedance of the autotransformer, and an at least one tuning capacitor disposed across the dc output power.

3. A power supply for inductively heating or melting an electrically conductive material, the power supply comprising:

a rectifier for converting an ac input power into a dc output power at the output of the rectifier, the output of the rectifier comprising a positive dc bus and a negative dc bus;

an inverter having a dc input connected to the output of the rectifier, the inverter comprising a first pair of first and third switch/diode assemblies and a second pair of second and fourth switch/diode assemblies, the four switch/diode assemblies forming a full bridge inverter with the first and second switch/diode assemblies each having a first terminal, in combination the two first terminals forming a positive dc inverter input, the positive dc inverter input connected to the positive dc bus, and the third and fourth switch/diode assemblies each having a first terminal, in combination the two first terminals forming a negative dc inverter input, the negative dc inverter input connected to the negative dc bus, the first and fourth switch/diode assemblies having a second terminal commonly connected together to form a first ac inverter output connection, the second and third switch/diode assemblies having a second terminal commonly connected together to form a second ac inverter output connection, the inverter converting the dc output power of the rectifier into an ac output current supplied to an output of the power supply, the ac output current having a frequency equal to the operating frequency of the inverter;

an at least one tuning capacitor having a first and second tuning capacitor terminals, the first and second tuning capacitor terminals connected across the positive dc inverter input and the negative dc inverter input, respectively, the connection between the first tuning capacitor terminal and the positive dc inverter input formed from a thin electrically conductive sheet, the connection between the second tuning capacitor terminal and the negative dc inverter input formed from a second thin electrically conductive sheet, the first and second electrically conductive sheets separated by a thin layer of high dielectric electrical insulation and joined together to form a low inductance connection;

an at least one inductive load coil connected across the first and second ac inverter output connections, the at least one inductive load coil having an inductance so that it is at

least approximately in resonance with the at least one tuning capacitor at the operating frequency of the inverter, whereby the electrically conductive material is inductively heated or melted by a magnetic field generated from the flow of the ac output current through the at least one inductive load coil.

4. The power supply of claim 3 wherein the at least one inductive load coil further comprises an active inductive load coil and an at least one passive inductive load coil, the at least one passive inductive load coil not connected to the active inductive load coil, the at least one passive inductive load coil connected in parallel with an at least one resonant passive circuit tuning capacitor to form a parallel tank resonant circuit, the passive inductive load coil magnetically coupled with the active inductive load coil when the ac output current flows through the active inductive load coil to induce a secondary ac current in the parallel tank resonant circuit, the impedance of the combination of the active inductive load coil and the parallel tank resonant circuit at least approximately in resonance with the impedance of the at least one tuning capacitor at the operating frequency of the inverter.

5. The power supply of claim 3 wherein the at least one tuning capacitor comprises a plurality of wound film capacitors, each of the plurality of wound film capacitors having a first and second capacitor conductors, all of the first capacitor conductors connected to a first electrically conductive capacitor sheet, and all of the second capacitor conductors connected to a second electrically conductive capacitor sheet, the first and second electrically conductive capacitor sheets separated by a thin layer of high dielectric electrical insulation and joined together to form a low inductance connection, the first electrically conductive capacitor sheet forming the first tuning capacitor terminal, and the second electrically conductive capacitor sheet forming the second tuning capacitor terminal.

6. The power supply of claim 5 wherein the plurality of wound film capacitors comprises a first group of wound film capacitors, each of the first group of wound film capacitors having their first capacitor conductors in contact with the first electrically conductive capacitor sheet, and a second group of wound film capacitors, each of the second group of wound film capacitors having their first capacitor conductors in contact with the second electrically conductive capacitor sheet, each of the first group of wound film capacitors having their second conductors in contact with the second electrically conductive capacitor sheet, and each of the second group of wound film capacitors having their first

capacitor conductors in contact with the second electrically conductive capacitor sheet.

7. The power supply of claim 6 wherein at least either the first or second electrically conductive capacitor sheet is pressed at least partially over each of the plurality of wound film capacitors.

8. A method of inductively heating or melting an electrically conductive material, the method comprising the steps of:

rectifying an ac output power into a dc output power at the output of a rectifier, the output of the rectifier comprising a positive dc bus and a negative dc bus;

forming an inverter from a first pair of first and third switch/diode assemblies and a second pair of second and fourth switch/diode assemblies, the four switch/diode assemblies forming a full bridge inverter with the first and second switch/diode assemblies each having a first terminal, in combination the two first terminals forming a positive dc inverter input, the positive dc inverter input connected to the positive dc bus, and the third and fourth switch/diode assemblies each having a negative dc inverter input, the negative dc inverter input connected to the negative dc bus, the first and fourth switch/diode assemblies having a second terminal commonly connected together to form a first ac output inverter connection, the second and third switch/diode assemblies having a second terminal commonly connected together to form a second ac output inverter connection, the inverter converting the dc output power of the rectifier into an ac output current supplied to an output of the power supply, the ac output current having a frequency equal to the operating frequency of the inverter;

connecting an at least one tuning capacitor having a first and second tuning capacitor terminals across the positive and negative dc inverter inputs, the first connection between the first tuning capacitor terminal and the positive dc inverter input formed from a first thin electrically conductive sheet, the second connection between the second tuning capacitor terminal and the negative dc inverter input formed from a second thin electrically conductive sheet;

separating the first and second thin electrically conductive sheets separated by a thin layer of high dielectric electrical insulation;

joining the first and second thin electrically conductive sheets together with the intervening thin layer of high dielectric electrical insulation to form a low inductance connection;

connecting the first and second ac inverter outputs to an at least one inductive load

coil to generate a magnetic field that magnetically couples with the electrically conductive material to inductively heat or melt the electrically conductive material; and

forming an at least approximately resonant circuit at the operating frequency of the inverter with the at least one inductive load coil and an the least one tuning capacitor.

9. The method of claim 8 further comprising the steps of:

inductively coupling a passive inductive load coil to the magnetic field generated by the at least one inductive load coil, the passive inductive load coil connected in parallel with an at least one resonant passive circuit tuning capacitor to form a parallel tank resonant circuit; and

forming an at least approximately resonant circuit at the operating frequency of the inverter with the impedance of the combination of the at least one inductive load coil and the parallel tank resonant circuit, and the at least one tuning capacitor.

10. The method of claim 8 further comprising the steps of: forming the at least one tuning capacitor from a plurality of wound film capacitors; connecting a first wound film capacitor terminal of each of the plurality of wound film capacitors to a first tuning capacitor connecting conductor, the first tuning capacitor connecting conductor formed from a third thin electrically conductive sheet; connecting a second wound film capacitor terminal of each of the plurality of wound film capacitors to a second tuning capacitor connecting conductor, the second tuning capacitor connecting conductor formed from a fourth thin electrically conductive sheet; separating the third and forth thin electrically conductive sheets separated by a thin layer of high dielectric electrical insulation; joining the third and fourth thin electrically conductive sheets together with the intervening thin layer of high dielectric electrical insulation to form a low inductance connection; forming the first tuning capacitor terminal from the third thin electrically conductive sheet; and forming the second tuning capacitor terminal from the fourth thin electrically conductive sheet.